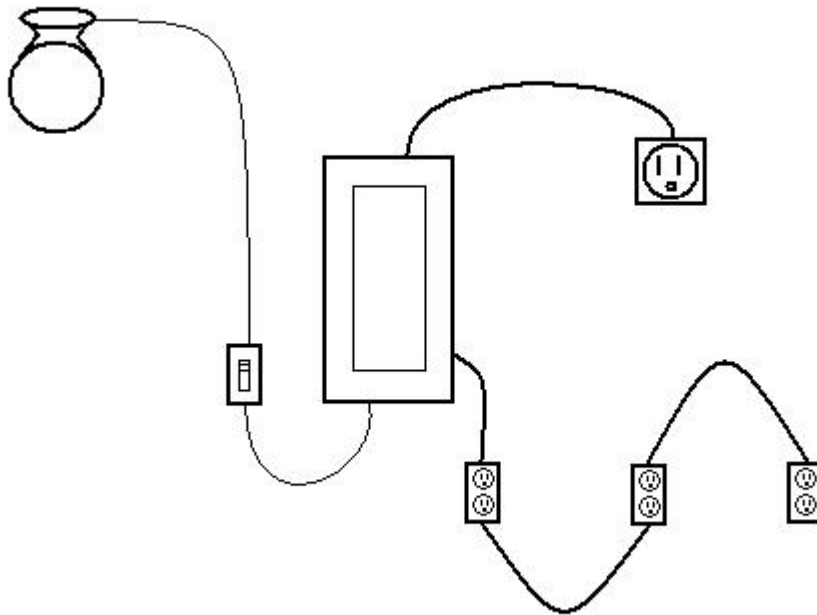


ELECTRICAL INFORMATION



**INFORMATION YOU NEED TO KNOW
IF YOU WANT TO DO IT YOURSELF**

GETTING AN ELECTRICAL PERMIT

An electrical permit is the simplest of all the building permits to obtain. The Oregon Electrical licensing and safety laws, however, are a bit confusing.

The electrical safety law says:

- * To do electrical work in Oregon, you must be licensed.
- * To do electrical work for others (even if you aren't being paid for it), you must work for a licensed electrical contractor.
- * You must be licensed to install pumps, furnaces, air conditioners, security systems, sound systems, fire alarm systems, vacuum systems, signs, and so forth and so on. This is to help protect you.
- * You must have an electrical license to do electrical work at the place where you work such as schools, hospitals, large commercial complexes, industrial plants and, well, you get the idea.

BUT, there is an exception for property owners. You may do your own electrical work on residential or farm property that you own and which is not for rent, sale lease or exchange. Either you or the members of your immediate family may do the work. "Immediate family" means father, mother, brother, sister, son, daughter, grandfather, grandmother, grandson, granddaughter and the "step" and "in-law" crowd too (sorry, second cousins are out).

However, electrical work on property which is for sale, lease, rent or exchange may only be done by a licensed electrical contractor.

Regardless of who is to do the wiring, Oregon law requires that electrical work be inspected to assure compliance with the electrical code and that it meets minimum safety standards.

An electrical permit is required and may be obtained at the Development Services Division, City Hall, 501 SW Madison, Corvallis, OR 97333. Inspections are usually scheduled by calling (541) 766-6745 and leaving the appropriate information. As long as the request is received by 7:00 AM, the inspection will be scheduled for the same day.

If you decide to do the work yourself, but have never done this kind of work before, we recommend that you seek the advice of a licensed electrical contractor.

The following pages list the types of inspections we conduct and some examples of the things we look for. We hope this information sheet will be of help to you. If you have any suggestions on how we may improve it, please let us know.

REQUIRED ELECTRICAL INSPECTIONS

Service, Cover or "Rough", Final

1) SERVICE INSPECTION:

Before the power company will connect the power to your electrical service panel, you will need a "SERVICE" inspection. The inspector will want to see the wiring made up properly in the meter base and the main panel. He will also check for the proper grounding and bonding of the system components. When you are ready, call for a "SERVICE" inspection.

DWELLING SERVICE EQUIPMENT

Check list

- a) For sizing the residential service entrance conductors use the table below.

Conductor types and sizes: RH, RHH, RHW, THHW, THW, THWN, THHN, XHHW, USE.
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SERVICE SIZE	"ALUMINUM"	"COPPER"
100 amps.....	#2 awg.....	#4 awg.
125 amps.....	#1/0 awg.....	#2 awg.
150 amps.....	#2/0 awg.....	#1 awg.
200 amps.....	#4/0 awg.....	#2/0 awg.
400 amps.....	#600 kcmil.....	#400 kcmil.

- b) The neutral conductor is generally sized to carry the calculated unbalanced load.
- c) Grounding electrode system consists of one or more of the following:
- Two 5/8" by 8 foot long galvanized or copper clad steel ground rods. Rods must be placed at least 6 feet apart.
 - Footing or "ufer" ground (see illustration on page 8). If re-bar is used in the footing, it is required to be used as a grounding electrode and the ground rods may be eliminated. However, in all cases, the interior metal water piping system must be bonded to the electrical system's service neutral conductor.
- d) Grounding electrode conductor and main bonding jumper sizes are based on the service entrance conductor size. Use table 250.66 in the National Electrical Code to size conductors for bonding to the water system's metal piping and to the grounding electrode system. The conductor to the ground rods should be a minimum #6 gauge copper for all installations. The size of the conductor to the footing or "ufer" ground will be selected from table 250.66 in the National Electrical Code and is based on the size of the service entrance conductors. However, the largest required conductor for the "ufer" ground is # 4 gauge copper.

- e) The bonding jumpers which connect all metal parts of the service equipment together are also based on table 250.66 of the National Electrical Code. If metal nipples and lock-nuts are used, a grounding bushing is required on the panel board end of the nipple. If a nipple encloses the grounding electrode conductor, grounding bushings are required on both ends of the nipple.
- f) If the service meter cannot be located adjacent to the service panel location, a "metered main" must be installed and a feeder is then run to a sub-panel. Four conductors are required for feeders to sub-panels. The neutral in the sub-panel **must not** be grounded to the enclosure and a separate ground bus must be installed for the connection of the **equipment ground** wires.
- g) Enclosures: Service equipment must be suitable for the location in which it is installed. For instance, if the panel is installed out doors, it must be of the "rain-tite" type also known as "weather proof" or "NEMA 3R".
- h) Conduit system support: Service risers must be supported according to the applicable articles in the electrical code which deal with the particular types of conduit systems installed. For example, Article 352 deals with rigid PVC conduit.

2) **COVER OR ROUGH-IN INSPECTION:**

Before you cover or conceal any electrical wiring in a wall, ceiling, floor, underground, etc., you will need a "COVER" inspection. The inspector will need to check for proper conductor support, protection from damage, wire size, etc. All of the cable jackets should be stripped off and the wiring in the boxes made up ready for the devices (switches, receptacles, lights) to be installed but don't install them. When you are ready, call for a "COVER" inspection.

ROUGH-IN CHECK LIST

GENERAL WIRING (code reference in parenthesis)

- a) Wiring must be properly stapled at intervals of 4½ feet and within 8" of each box. (334.30 and 314.17(C))
- b) Wiring set back from edge of stud 1¼" (300.4(A)).
- c) No more than two cables per staple (Oregon interpretations of 334.30).
- d) Nail plates where required. (300.4(A))
- e) Number of conductors in the box. (314.16)
- f) Breaker boxes must be located so as to be readily accessible. They should not be located in closets or bathrooms. (240.24 and 230.70(A))
- g) Sub-panel neutral isolated from ground and separate equipment grounding bar installed. (250.24)
- h) Six inches of free conductor at each splice point. The wires must be long enough to extend at least 3 inches outside of the box. (300.14)
- I) Neutrals pig-tailed on multi-wire branch circuits. (300.13B)
- j) Equipment grounding conductors properly spliced and "pigtailed". (250.148)
- k) Underground wiring installed at proper depth. (300.5)
- l) Bonding jumper of proper size run to interior metal piping such as water and gas piping. (250.104)
- m) Proper grounding of metal parts at water well. (pump motor, casing, piping and etc). (250.112M)
- n) Protection of cables at attic access. (334.23 and 320.23)
- o) Required smoke detectors properly placed and interconnected. (Building Code)

- p) Range and dryer cables must be 4 wire cables. (250.134, 250.138 and 250.140)

RECEPTACLE OUTLETS

- a) General outlets (habitable rooms). Outlet within 6 feet of any wall space. A wall space that is 2 feet or more in width will require a receptacle outlet. (210.52(A))
- b) 20 amp laundry circuit. (#12 wire with no other outlets). (210.52(F) and 210.11(C))
- c) Small appliance circuits in kitchen. (No lighting or outside outlets permitted on these circuits).
 - Two 20 amp (#12 Gauge wire) at counter top. (210.52B and 210.11(C))
 - Check spacing along counter top. Receptacle outlets are to be spaced so that there is an outlet within 2 feet of any counter top surface. Counter top spaces that are 12 or more inches wide will require an outlet. (210.52(C))
- d) Wall mounted receptacle outlet(s) within 36 inches of the bathroom sink(s). The circuit for the bathroom receptacle outlets must be a 20 amp (#12 Gauge wire) circuit dedicated for these receptacles. This circuit may supply the receptacles in more than one bathroom. (210.11(C) and 210.52(D))
- e) Outside outlets (one in front and back) accessible from grade. (210.52(E))
- f) Basement outlet. A receptacle must be installed in each unfinished basement area. (210.52(G))
- g) Attic outlet that may be required for servicing of equipment. (210.52(G) and 210.63)
- h) Garage outlet. Note that electrical equipment that can cause an arc or spark such as receptacles and switches must be located more than 18 inches above the floor. (210.52(G))
- i) Hallway outlet if hall is 10 feet or more in length. (210.52(H))
- j) Hallway alcoves that measure 2 feet by 3 feet or larger will require a receptacle outlet in the alcove which will be in addition to the required hallway outlet. (918-305-0130)
- k) Outside receptacle located within 25 feet of outdoor HVAC equipment. (210.63)
- l) Outside balconies, porches and decks which measure 20 square feet or more will require a receptacle outlet for that area. (210.52(E))
- m) After October 1, 2008, all receptacles in dwellings will be required to be of the tamper resistant type. (406.11)

LIGHTING OUTLETS

- a) Switched light or receptacle outlet at each entrance from outside and at each habitable room, hallway, stairway or attached garage. (210.70(A))
- b) Switched light required at attic or under floor for service of equipment or if used for storage. (210.70(A))
- c) Location of lighting outlets in clothes closets. Incandescent type lamps must be completely enclosed. (410.8)
- d) Check recessed fixtures for "I.C." rating. (410.116)
- e) Note any approved ceiling fan support boxes. (314.27)
- f) Outside light fixture box installed at each exit door. (210.70(A))

3) FINAL INSPECTION:

When the installation is complete you must call for a "FINAL" inspection. At this time the entire electrical system must be complete; for example, all the light fixtures, receptacle outlets, switches (including the wall plates), appliances and so forth must be installed and working.

FINAL CHECKLIST

GENERAL:

- a) No open wiring hanging out. (all devices, fixtures, etc. installed)
- b) Check for equipment listing/labeling. (110.3(B))
- c) Number and location of receptacle outlets. (210.52)
- d) Switches and receptacles installed and have proper covers.
- e) Sunlight rating on outdoor wiring systems. (300.6)
- f) Cord and cord cap on garbage disposal if the appliance is cord-and-plug connected. (422.16)

DISCONNECTS REQUIRED:

- a) H.V.A.C. equipment. (440.14)
- b) Appliances fastened in place.
 - Water heater. (Breaker lock-out is permitted in lieu of local disconnect.) (422.31)
 - Jacuzzi bathtub. (422.32)
 - Spa. (680.12)
 - Electric heaters. (Breaker lock-out is permitted in lieu of local disconnect.) (424.19)

RECEPTACLE OUTLETS:

- a) Verify functioning of G.F.C.I. protection of receptacles and circuits. (210.8 and 210.52)
 - ALL outside receptacles.
 - Garage receptacles.
 - ALL bathroom receptacles.
 - ALL kitchen counter top receptacles.
 - Hydromassage bath tub circuit.
 - Basement receptacles (unfinished basement rooms).
 - Spa circuits. (all voltages)
- b) At least one receptacle in attic or un-finished basement used for storage or that contains equipment requiring maintenance. (210.52(G) and 210.8)
- c) Receptacle outlets have proper polarity and are grounded. (200.11 and 406.9)
- d) Receptacles at the kitchen counters should be spaced so that no counter top is farther than 2 feet from an outlet. Counter tops that are 12 inches by 24 inches or larger require an outlet to serve the counter space, including counter tops on islands and peninsulas. (210.52)

LIGHTING OUTLETS:

- a) One switched lighting outlet (or receptacle) in each habitable room. (210.70)
- b) One exterior lighting outlet at each exit door. (210.70)
- c) Location and type of clothes closet lighting fixture. (410.8)
- d) Heavy fixtures properly supported. (410.36 and 314.27 (A)&(B))
- e) Ceiling paddle fans properly supported. (314.27)
- f) Fixtures suitable for location (damp, wet or I.C. rated). (410.10)
- g) One light in attic or un-finished basement used for storage or that contains equipment requiring maintenance. (210.70(A))

GROUNDING AND BONDING OF EQUIPMENT:

- a) Hydromassage bath tub.
- b) Spa equipment.
- c) Main and sub-panels.
- d) Appliances.

WORKING ROOM ABOUT EQUIPMENT: (110.26)

- a) Clearance for all electrical equipment, including panels, disconnects and appliances.

PANELS, SUB-PANELS, AND DISCONNECTS:

- a) Proper location and clearances for electrical panels. (110.26)
- b) Circuit directory filled out. (110.22 and 408.4)
- c) Proper over current device for wire size. (240.4 and 310.16)
- d) Proper over current device per manufacturer's requirement. (110.3)
- e) Sub-panel neutral isolated from ground. (250.24 and 408.40)
- f) Branch circuit grounds and neutrals on proper busses. (250.24)
- g) Two pole breakers have proper handle ties. (240.15)

ARC FAULT PROTECTION:

All 120 volt, 15 and 20 amp circuits serving bedrooms shall be protected by arc fault circuit interrupters. This includes lights and receptacles. (210.12)

A FEW LAST THINGS TO REMEMBER

For dwelling services, the neutral bus must be connected to the metal water piping system as well as to the UFER or ground rods. For a typical 200 amp service with 4/0 aluminum service conductors, a #4 gauge copper conductor is required for the water piping bond wire and for connection to the UFER ground. A #6 gauge or larger copper conductor is required for the wire to the ground rod(s).

If #4 or larger reinforcing bar is used in the footing, it is required to be used for grounding the electrical service and the ground rods may then be eliminated (please see the illustrations on page 8).

The two 20 amp small appliance circuits required for the kitchen counter top areas may not have any other fixed appliances or lighting connected to them. They shall also serve the receptacles in the dining room, and breakfast nook areas. Space the receptacles on the counter tops so that no point along the counter top is farther than two feet from an outlet. Counter tops 12 inches and wider will require a receptacle for that space.

Dishwashers and garbage disposals, because of their size, generally should each have their own separate circuits.

G.F.C.I. protection is required for all receptacles:

- a) In bathrooms
- b) Readily accessible receptacles in garages
- c) Readily accessible receptacles in accessory buildings that have a floor located at or below grade level not intended as habitable rooms and limited to storage areas, work areas, and areas of similar use

- d) Outdoors
- e) In unfinished basement rooms and crawl spaces
- f) In kitchens where the receptacles are installed to serve the counter top surfaces
- g) Within 6 feet of laundry, utility and wet bar sinks
- h) In boat houses.

When using crimp sleeves for making up the ground wires in the switch, light and receptacle boxes, be sure to twist the wires together first, then use the proper crimping tool recommended by the manufacturer. The crimp tool from the auto parts store is probably not the right one!!! Wire nuts are the preferred method for splicing.

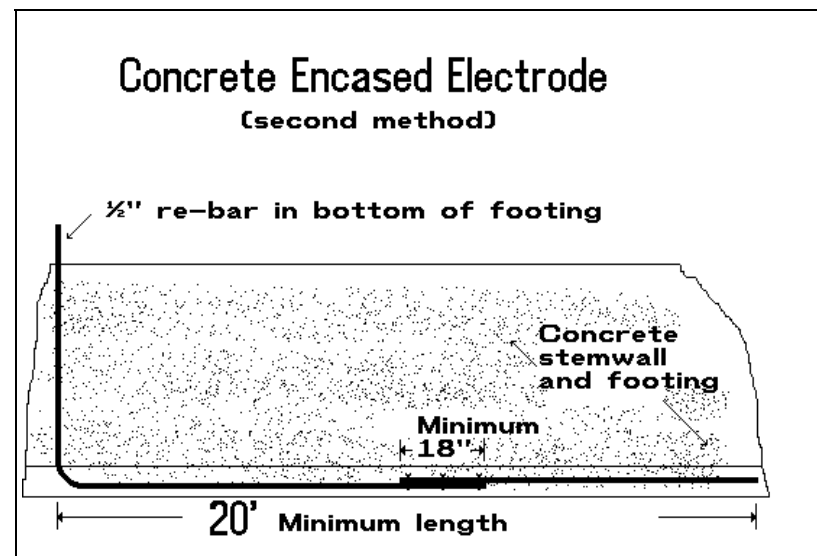
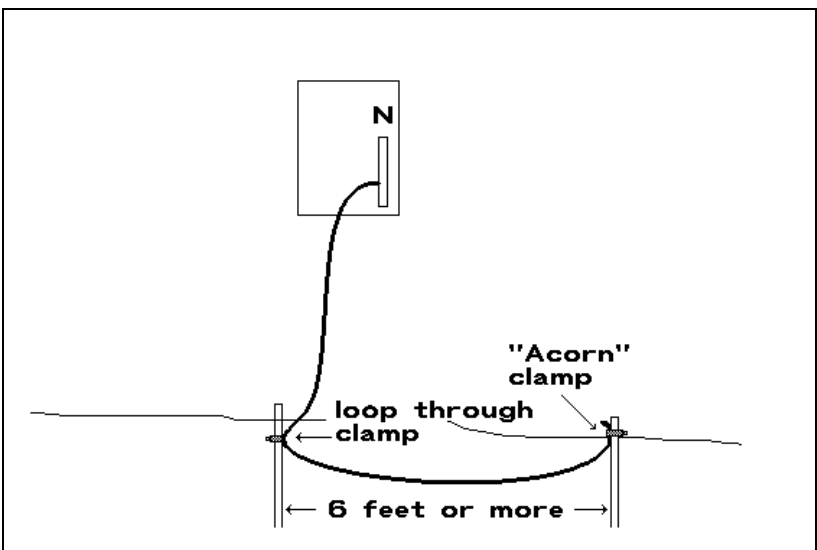
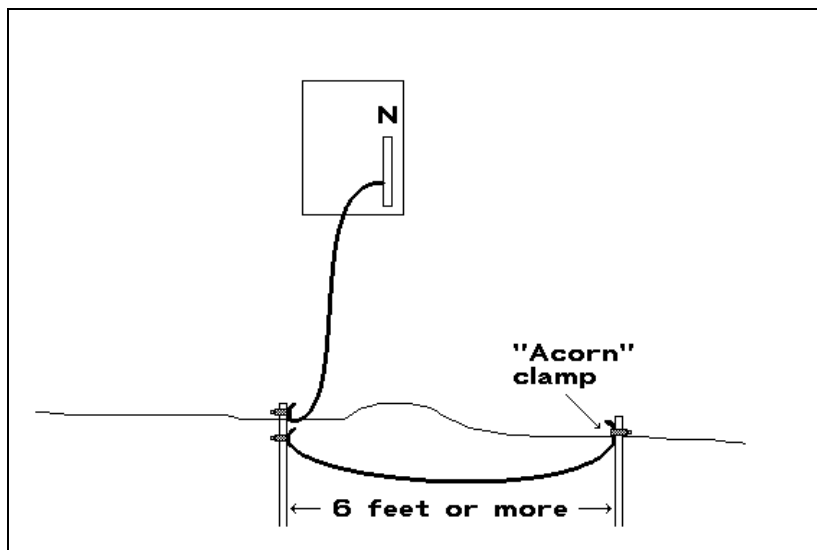
All appliances that are fastened in place require a local means to shut off or disconnect all power to the appliance. This "disconnect" must be within 50 feet and directly within sight of the appliance served. For some appliances such as the garbage disposal, the switch on the wall can serve as the required disconnect. In lieu of the local switch, a breaker lockout device may be substituted for some appliances such as the water heater, electric wall heaters and ranges or cook tops that are hard wired. If you have any questions, please call. We will be glad to let you know whether the appliance you're wiring needs a local disconnect, or if you may be able to use a breaker lockout instead.

CHECK WITH THE POWER COMPANY.-- Check for specific requirements on service equipment such as location of meter, type of meter base, size of underground entrance conduit and burial depth. As an example, meter bases for installations other than dwellings may require the "bypass link" type base and entrance conduit elbows must have a 36" radius. Other requirements may also apply.

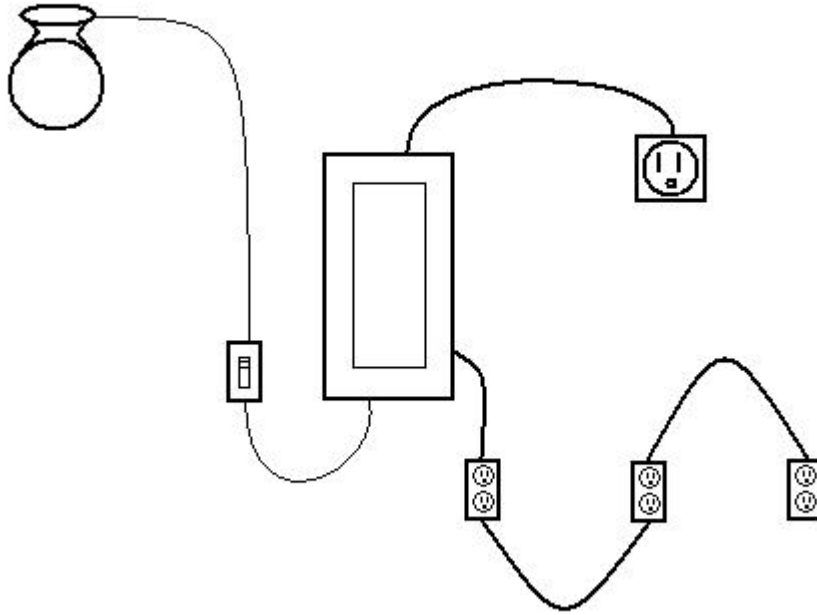
Generally, any corrections noted during an inspection must be completed within 20 days and a re-inspection called for.

While we are not permitted to design your electrical system for you, we will be glad to tell you what the electrical code requires. If you have any questions regarding the code, please feel free to contact our electrical inspector at 1-541-766-6929. The best time to call is between 7:30 am to 8:00 am and 3:30 pm to 4:00 pm..

Where the only ground is a made electrode such as a ground rod, the code requires two rods unless it can be documented that there is 25 ohms or less resistance to ground. The ground wire running between the two rods must be protected by burial at least **24 inches** below grade. If the installation is made next to a building wall, it may be run along the building and stapled or otherwise securely fastened to the structure to protect it.



ELECTRICAL TERMINOLOGY



A.F.C.I. (Arc Fault Circuit Interrupter):

An arc-fault circuit interrupter is a device intended to provide protection from the effects of arc faults by recognizing characteristics unique to arcing and by functioning to de-energize the circuit when an arc fault is detected.

BONDING:

The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed.

BONDING JUMPER:

A reliable conductor used to bond metallic parts of equipment.

BRANCH CIRCUIT:

The wiring from the last breaker to the outlets or equipment such as receptacles, lights or appliances. In the illustration above, there are three branch circuits. One for the light and switch, one for the three duplex receptacles and one for the single receptacle.

CONDUCTOR:

A material, usually of copper or aluminum, which will readily conduct electricity. Conductors may be bare, covered or insulated.

DISCONNECT:

A device (usually a switch) which is used to disconnect the conductors of a circuit from their source of electrical supply.

DRIP LOOP:

A loop of excess conductor hanging below the weather head that prevents water from entering the service riser.

EQUIPMENT GROUND:

The conductor used to connect the noncurrent-carrying metal parts of equipment, raceways and other enclosures to the electrical system ground.

FEEDER:

The wiring between the service panel and the sub-panel.

G.F.C.I. (GROUND FAULT CIRCUIT INTERRUPTER):

A device intended for the protection of personnel that functions to de-energize a circuit when an electrical current to ground occurs outside the normal circuit path.

GROUND:

A conducting connection between an electrical circuit and the earth, or some body serving in place of the earth.

OUTLET:

A point on the wiring system at which current is taken to supply utilization equipment.

Lighting outlet:

An outlet intended for the direct connection of a lamp holder or lighting fixture.

Receptacle outlet:

An outlet where one or more receptacles are installed. A receptacle is a device installed at the outlet for the connection of an attachment plug.

SERVICE:

The part of the wiring system from the utility company connections to the panel which contains the "main" breaker. This includes the conduit and conductors in the service mast and meter base.

SERVICE RISER:

The conduit, conductors and other equipment necessary to bring the utility system power into the premises meter or service equipment.

SUB-PANEL:

An electrical panel with circuit breakers or fuses which is fed by the main service panel or another sub-panel.

UFER (Concrete Encased Electrode):

The ½ inch x 20 foot re-bar in the footing that is used as the electrical system grounding electrode.

WEATHER HEAD:

The weatherproof top cap on an overhead service riser through which the service entrance conductors extend for the connection to the utility company supply conductors.